A POPULATION ESTIMATE FOR THE BLUENOSE CARIBOU HERD IN 1981

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A POPULATION ESTIMATE FOR THE BLUENOSE CARIBOU HERD IN 1981

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ABSTRACT

Numerous population estimates have been made for the Bluenose caribou herd. Estimates made between 1949 and 1974 ranged from 5,000 to 92,000 caribou and are of questionable reliability. Estimates since then have ranged only from 35,000 to 46,000 caribou. This study involved a thorough reconnaissance of the herd's range north of the tree line. The calving areas were located, stratified and surveyed using strip transects. We estimated 17,200 ± 1,560 (S.E.) caribou, one year old and older in the five calving ground strata combined. The population estimate for the entire herd was 38,000 caribou (95 percent confidence limits = ± 18,000). Classification of caribou on the calving grounds immediately after the aerial survey indicated that 74 ± 7.5 percent of the caribou on the calving grounds were breeding females.

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INTRODUCTION

Numerous population estimates have been reported for the Bluenose caribou herd (see Carruthers and Jakimchuk [1981] for a review). Between 1949 and 1954 the herd apparently remained stable at approximately 30,000 animals. From 1955 to 1960 the estimates suggested that the herd declined to approximately 10,000. Those early estimates must be interpreted cautiously since aerial coverage was often incomplete, with the investigators overlooking large areas that presently lie within the known range of the Bluenose herd. A 1967 estimate by Thomas (1969) of 16,000 caribou suffered from the same problem. Hawley and Pearson (1966) flew a much greater portion of the range and they estimated 39,000 caribou in 1966. They also extrapolated those data to the entire area encompassed by the Mackenzie and Coppermine rivers, the Arctic Ocean and Great Bear Lake, and arrived at an estimate of 53,000 caribou. More recent population estimates of 92,000 in 1974 (Hawley et al. 1976) and 42-72,000 in 1977 (Wooley and Mair 1977) are higher than the earlier studies. Both of those studies used the strip transect technique over large areas that included both tundra and boreal forest. None of the estimates made between 1949 and 1977 were accompanied by a measure of their precision. Surveys in 1978 and 1979 by Brackett et al. (1982) used the calving ground technique whereby the boundaries of all areas in which calving occurs are delimited through reconnaissance; the calving areas are then surveyed using strip transects. A population estimate is extrapolated from the estimate of parturient females on the calving grounds and the proportion of

those in the total population. The 1978 and 1979 calving ground surveys resulted in population estimates of 27,000 and 35,000, respectively. Weather and funds prevented a reconnaissance of the entire range in 1978, particularly the area east and southeast of Bluenose Lake where it was suspected that calving occurred, therefore, the 1979 survey was considered to be more reliable (Brackett et al. 1982). Carruthers and Jakimchuk (1981) summarized two years of work on the winter range of the Bluenose herd and estimated the population size at 39,000 animals.

The objective of this study was to estimate the population of Bluenose caribou, using the calving ground technique. Particular emphasis was placed on extensive reconnaissance to find all areas of calving and classification of animals within the census zone to reduce the assumptions required to arrive at a total population estimate.

MATERIALS AND METHODS

The study area included the entire region north of Great Bear Lake to the Arctic Ocean, bounded by the Mackenzie River in the west and the Coppermine River in the east. The study area was divided into east and west halves at the Hornaday River (Fig. 1). Reconnaissance was performed by two teams; the eastern team was based at Bluenose Lake, the other at Paulatuk. Regular radio contact facilitated co-ordination between the two teams. Each survey aircraft (Cessna 185) had two observers in the rear seats and a navigator-recorder seated in the front. Reconnaissance flight lines 25 km apart were drawn on 1:1,000,000 topographical maps of the study area. These lines served as general routes to be followed by each team, with sufficient flexibility that lines could be omitted or route deviations made depending on caribou signs encountered. Reconnaissance was flown at an altitude of 122 m and an airspeed of 180-190 km/h. The number of caribou observed, both inside and outside a 400 m strip on both sides of the plane, was recorded on tape. Wing strut markers served as the outside and inside edges of the strip, thereby excluding the blind spot beneath the plane from the survey strip. The navigator-recorder plotted the location of all caribou sightings on 1:250,000 maps. Caribou were classified whenever possible as yearlings, cows, cows with calves or bulls. Reconnaissance flights were flown on 29 and 30 May and 3-5 June by the Paulatuk team, and 29-31 May, 1 and 6 June by the Bluenose team. Poor weather interrupted the work of both teams.

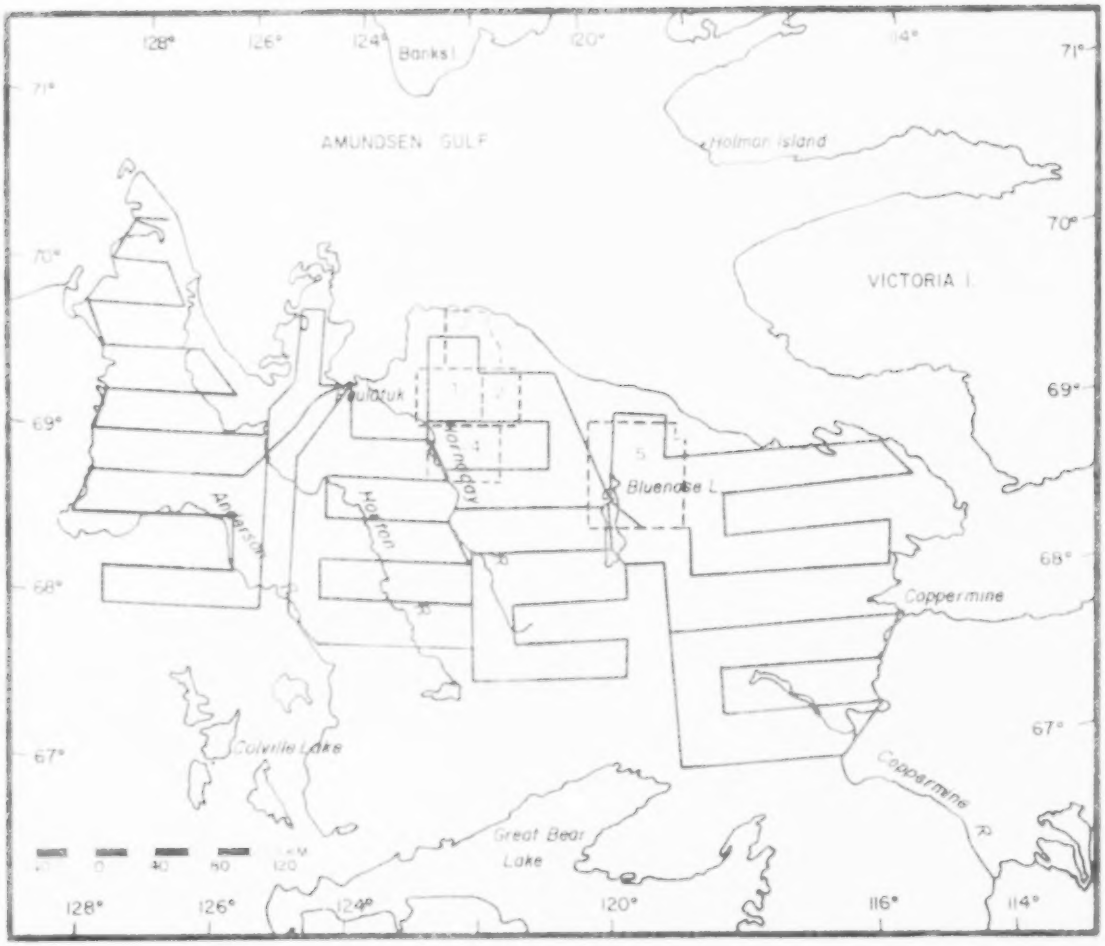

Figure 1. Location of the reconnaissance transects and the five strata occupied by Bluenose caribou during the June 1981 census.

The calving grounds were delineated after all reconnaissance was completed. We designated calving areas based on the presence or absence of adult female caribou. No arbitrary minimum encounter rate was required, as adult female (parturient) caribou were either present at high density or not present at all.

Once calving areas (hereafter referred to as strata) were set, transects oriented perpendicular to the long axis of each stratum were drawn. Transects were spaced at 3.2 km, 4.3 km, 5 km and 8 km intervals, depending on the coverage desired (Heard 1981a). Strata having high densities of adult female caribou received greater coverage than strata with lower densities. The transects were flown at an altitude of 122 m and an airspeed of 160-170 km/h. All caribou one year and older within a 400 m strip on either side of the plane were counted and recorded on tape. Each observation was assigned a checkpoint number which was entered onto the map by the navigator-recorder. Where possible, we classified individuals as lone cows, yearlings or bulls. Both survey teams performed strata sampling. Local weather conditions determined which team did particular strata. Variance estimates for the population estimates were obtained using Jolly's method (Jolly 1969).

The composition of caribou present on the strata was determined immediately after strata sampling. Two workers were placed on the ground by helicopter (Bell 206B) near groups of caribou. As many caribou as possible in a group were then classified with the aid of a spotting scope. One worker acted as the observer while the other recorded. Caribou were classified as

breeding female with calf, lone breeding female, non-breeding female, yearling or bull. Breeding condition was determined by the presence of a distended udder, readily visible when the animal was viewed from the rear. Yearlings were identifiable by size and juvenile facial features. In addition, we recorded the number of antlers carried by adult females.

The population estimate in this study was calculated as described by Heard (1981b) using the calving ground classification data from this study and sex ratio determined by Brackett et al. (1982). Brackett classified aggregations of caribou during the autumn rut when they were well mixed and migrating to the winter range.

We recorded all observations of muskoxen (Ovibos moschatus), wolves (Canis lupus) and grizzly bears (Ursus arctos) seen during our flights.

RESULTS

Reconnaissance

The Paulatuk and Bluenose Lake teams spent 12.3 and 22.5 flying hours, respectively, in reconnaissance. All of the tundra east of Anderson River was surveyed, as were areas below the tree line between Simpson and Tadenet lakes and near Ewariege Lake (Fig. 1). The extreme southern portion of the area including Horton Lake, Bloody River and Caribou Peninsula, which were initially designated as regions to be reconnoitered, were bypassed because caribou density was very low immediately north of these areas.

Adult females and females with calves were concentrated northwest of Bluenose Lake in an area encompassed by the Roscoe, Brock and Hornaday rivers (Fig. 1, strata 1 and 2). Lesser concentrations were situated on the north slope of the Melville Hills immediately south of Albert Bay (stratum 3) between Bluenose Lake and Hornaday River (stratum 4) and between Bluenose Lake and Clinton Point (stratum 5). Few lone females and only two females with calves were sighted on the Bathurst Peninsula during a reconnaissance flight on 29 May. Bulls were observed in the Anderson River, Lac Rouviere and Dismal Lakes areas immediately below, or on the tree line. Yearlings were noted throughout the reconnoitered area with major concentrations on the coastal plain north of Melville Hills, the lower Hornaday River and the area surrounding Bluenose Lake. Few caribou were sighted in the area between Bluenose Lake and Cape Krusenstern. Many old tracks were observed in the Rae River area, suggesting that caribou moved in a northwesterly direction out of this area.

Stratification

Five strata were identified based on the results of reconnaissance flights over the study area (Fig. 1). Stata 1 and 2 had the highest density of non-calf caribou, strata 3-5 had considerably lower densities (Table 1). We allocated more survey effort (i.e., we flew more transects) in the high density strata than in the low density strata (Table 1). The Paulatuk team sampled strata 1, 3 and 4 (9.1 flying hours); the Bluenose team strata 2 and 5 (7.6 flying hours). The 3,464 non-calf caribou observed within all strip transects extrapolates to an estimate of 17,200 $\pm$ 1,560 (S.E.) non-calf caribou. No significant differences were detected between observers in either the Paulatuk or Bluenose teams (Wilcoxon matched pairs test; $Z = 0.10$, $P > 0.05$). Observability of caribou was good except for stratum 1 where evening light caused some deterioration in observability. Snow cover on all strata averaged 10 percent except in some of the highest regions of the Melville Hills, where local areas still retained 90 percent snow cover.

Tape recorder malfunction (belonging to the left observer) during the first survey of stratum 5 necessitated a repeat survey the following day. On the first survey, because of the time of day (1830-2230 hrs), light conditions on the east side of the plane were far superior to the west side for observing caribou. On the repeat survey, however, when light conditions were uniform, both observers recorded only 17 percent more caribou than did the right observer alone the previous evening. On the second survey, the right observer recorded fewer caribou than on the first (474 vs. 348).

Table 1. Strata characteristics and caribou observations during strip transect survey in 1981.

	Stratum					
	1	2	3	4	5	
	5 June	6 June	6 June	7 June	8 June	Strata combined
N	48	35	43	53	90	269
n	13	10	10	10	10	53
Z	1416	1425	967	1537	4600	9945
z	385	296	182	272	518	1653
c	27%	29%	23%	19%	11%	
y	1844	628	71	347	574	3464
R	4.8	2.1	0.39	1.3	1.1	1.7
Y	6800	3000	380	2000	5100	17,200
Var(Y)	6.6×10^5	7.1×10^5	4.4×10^3	2.5×10^5	8.0×10^5	2.4×10^6
SE(Y)	810	840	66	500	910	1560
CV	0.12	0.28	0.18	0.25	0.18	0.09
df						15

N - maximum number of transects
n - number of transects surveyed
Z - stratum area (km^2)
z - strip area (km^2)
c - coverage (n/N)
y - number of caribou counted
R - caribou density (caribou/km^2)
Y - population estimate
Var(Y) - population variance
SE(Y) - standard error
CV - coefficient of variation
df - degrees of freedom (after Cochran 1977:90)

Calving Ground Classification

We used 9 flying hours of helicopter time, from 11-13 June in classifying caribou. All strata except stratum 3 were sampled; however, the majority of sample sites were in strata 1 and 2. We classified 2,626 caribou. Of the non-calf caribou on strata 1-5, 74 ± 7.5 percent were breeding females (Table 2). There were 92 calves per 100 breeding females, suggesting that 8 percent of breeding females had lost their calves prior to our work or had not yet calved.

Significantly more females with calves had retained at least one antler at the time of classification, than had breeding females without calves (Table 3; $X^2 = 61.8$, $P > 0.005$). Thus, most of the breeding females without calves had probably born a calf that subsequently died. If they were still pregnant they should still have had antlers (Bergerud 1976, Heard 1981b). The peak of calving was approximately 7 June.

Calculation of Population Estimate

Using the method described by Heard (1981b), we estimated the total population size to be 38,000 (Table 4). The 95 percent confidence limits were calculated as ± 18,000 (Appendix A).

Table 2. Reproductive status of Bluenose caribou on the calving ground in 1981.

Category	Number of animals			
	11 June	12 June	13 June	Total
Breeding females[1] with calf	474	863	445	1782
Breeding females without calf	58	60	32	150
Barren females	70	57	63	191
Yearlings	145	100	243	488
Bulls	0	9	6	15
Total	748	1089	789	2626
Breeding females as % of total	71	85	60	74±7.5[2]
Calves per 100 breeding females	89	93	93	92

1 Females with visible udders.

2 After Snedecor and Cochran (1967:241 equation 9.8.4).

Table 3. Antler retention by a sample of breeding female caribou from the Bluenose herd in 1981.

	Number of Antlers			
	0	1	2	Total
Females with calves	15(33%)	7(14%)	26(53%)	49
Breeding females with no calves	101(77%)	8(6%)	23(17%)	132
Total	116	15	49	181

Table 4. Calculation of the population estimate from the estimated size of the calving ground population (after Heard 1981b).

$$\text{Population estimate} = \frac{\text{correction for observer bias} \times \text{proportion of animals on the calving ground that are breeding females} \times \text{calving ground estimate}}{\text{proportion of females in population} \times \text{proportion of females that breed}}$$

$$= \frac{(1.25)(0.74)(17,200)}{(0.58)(0.72)}$$

$$= 38,000$$

DISCUSSION

Female caribou with calves and pregnant females were concentrated in the same areas described by Hawley et al. (1976) and Brackett et al. (1982). Hawley reported a small concentration (number unspecified) of calving females on the Bathurst Peninsula. We observed no concentration of female caribou on the Bathurst Peninsula, although two new-born calves were observed there. Brackett et al. (1982) also reported a few calves on the Bathurst Peninsula. These animals are likely Bluenose caribou, however, the possibility of them being reindeer cannot be discounted. D. Nasogaluak (pers. comm.) stated that occassionally reindeer wander that far east and may calve there. There was no evidence, after extensive reconnaissance, of Brackett et al.'s (1982) suggestion that calving may occur southeast of Bluenose Lake. It is apparent, after several studies, that Bluenose caribou favour the high, rugged terrain north and northwest of Bluenose Lake as their traditional calving ground.

The population estimate in this study is higher than the first estimate obtained by the calving ground technique in 1978 of 27,000, but agrees closely with the more extensive 1979 survey of 37,000 (Brackett et al. 1982) and aerial surveys in 1981 on the winter range by Carruthers and Jakimchuk (1981), where they estimate 38,000 caribou. Our survey error (C.V. = 0.09) compared favourably with several other recent calving ground surveys (Heard and Decker 1980, C.V. = 0.09; Heard 1981b, C.V. = 0.11; Gunn and Decker 1982, C.V. = 0.07).

The size of the Bluenose caribou herd appears to have been relatively stable since 1966, ranging between 27,000 and 42,000 animals, with the exception of the 1974 estimate of 92,000. Our estimate gives no indication that the herd will not remain within that range in the near future.

Given a low predation rate caribou populations can support about a 5 percent harvest (Bergerud 1978). There are few wolves and, therefore, relatively little predation on Bluenose caribou. However, the annual kill by hunters is about 3,000 caribou (8% of herd); exceeding the suggested maximum. A commercial quota of 800 exists, of which approximately half, or 1 percent of the population, is taken in an average year. We believe that the herd must be very close to the maximum sustained yield. Any substantial increase in predation or hunting would probably cause the herd to decline. If this were the case, the commercial quota should be reduced.

Post-calving classification indicated that 8 percent of all breeding females were without calves when we made our observations. Presumably, the majority of these were a result of still-births or neonatal mortality caused by such factors as separation, weather or accidental injury. A grizzly sow with cub was the only potential predator observed on the calving ground, therefore, predation of calves was probably negligible. It is unlikely that many of this 8 percent were still pregnant since none had obviously distended abdomens, and the majority (77%) had already lost both antlers. Antlers are shed soon after parturition (Heard 1981b). An 8 percent loss within approximately

one week of peak calving time (7 June for most herds studied) is in general agreement with other studies of barren-ground caribou (Heard 1981b).

Tracks suggested that caribou had recently (approximately mid-May) moved northwest from the Rae and Richardson rivers. Those animals probably wintered on the tundra.

One wolf was observed at Dismal Lake, approximately 250 km S.E. of the main calving ground.

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PERSONNAL COMMUNICATIONS

Nasogaluak, David. Reindeer rancher, Tuktoyaktuk, NWT.

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Appendix A. Calculation of the standard error of the total population estimate.

The total population is calculated based on four variables with associated variances and the correction for observer bias, for which we assume variance is zero (Table 1, Heard 1981b). The variance of the total population (Vt) is related to those variables and their variances as follows (after Heard 1984):

$$Vt = (T^2)\ (CV_a^2 + CV_b^2 + CV_c^2 + CV_d^2)$$

where T = estimate of the total population
CV_i = coefficiant of variation of variable i
a = calving ground estimate
b = proportion of breeding females on the calving ground
c = proportion of females in the population
and d = proportion of females that breed.

1. $CVa = 2.4 \times 10^6 / 17{,}200$
$= 0.009$

2. $CVb = 0.0169 / 0.74$
$= 0.176$

3. $CVc = 0.003186 / 0.58$
$= 0.097$

4. CVd assumed to be 0.005

$\therefore\ Vt = (38{,}000)^2 (0.090^2 + 0.176^2 + 0.097^2 + 0.050^2)^2$
$= 73.6 \times 10^6$
$SEt = 8582$
$CVt = 0.23$

95% confidence limits are $38{,}000 \pm (8582)(t_{0.05,\ 15})$
$\pm (8582)(2.131)$
$\pm 18{,}000$
or 20,000 to 56,000

Appendix B. Number and density of caribou observed per transect in strata 1 through 5.

Stratum 1

Transect			Observations					
			Adults		Total			Density
Number	Length (km)	Area (km^2)	Left obs.	Right obs.	adults	Calves	Total	caribou (km^2)
1	37.0	29.6	103	56	159	84	243	8.2
2	37.0	29.6	43	117	160	44	204	6.9
3	37.0	29.6	45	114	159	96	255	8.6
4	37.0	29.6	55	65	120	48	168	5.7
5	37.0	29.6	174	140	314	122	436	14.7
6	37.0	29.6	113	99	212	60	272	9.2
7	37.0	29.6	112	66	178	39	217	7.3
8	37.0	29.6	29	57	86	44	130	4.4
9	37.0	29.6	130	35	165	41	206	7.0
10	37.0	29.6	16	32	48	18	66	2.2
11	37.0	29.6	34	35	69	18	87	2.9
12	37.0	29.6	34	40	74	17	91	3.1
13	37.0	29.6	53	47	100	16	116	3.9

Appendix B continued

Stratum 2

Transect			Observations					
			Adults					
Number	Length (km)	Area (km^2)	Left obs.	Right obs.	Total adults	Calves	Total	Density caribou (km^2)
1	37.0	29.6	2	4	6	3	9	0.3
2	37.0	29.6	1	6	7	1	8	0.3
3	37.0	29.6	8	4	12	6	18	0.6
4	37.0	29.6	9	20	29	8	37	1.3
5	37.0	29.6	13	8	21	6	27	0.9
6	37.0	29.6	8	10	18	0	18	0.6
7	37.0	29.6	34	23	57	20	77	2.6
8	37.0	29.6	29	33	62	19	81	2.7
9	37.0	29.6	71	46	117	62	179	6.1
10	37.0	29.6	130	169	299	70	369	12.5

Appendix B continued

Stratum 3

Transect			Observations					
			Adults		Total			Density
Number	Length (km)	Area (km^2)	Left obs.	Right obs.	adults	Calves	Total	caribou (km^2)
1	17.3	13.8	0	0	0	0	0	0.0
2	17.3	13.8	0	4	4	0	4	0.3
3	17.3	13.8	10	8	18	4	22	1.6
4	17.3	13.8	4	5	9	5	14	1.0
5	21.0	16.8	7	2	9	5	14	0.8
6	24.8	19.8	0	0	0	0	0	0.0
7	27.0	21.6	6	1	7	3	10	0.5
8	27.0	21.6	5	1	6	3	9	0.5
9	29.3	23.4	4	5	9	1	10	0.4
10	29.5	23.6	2	7	9	3	12	0.5

Appendix B continued

Stratum 4

Transect			Observations					
			Adults		Total			
Number	Length (km)	Area (km^2)	Left obs.	Right obs.	adults	Calves	Total	Density caribou (km^2)
1	34.0	27.2	2	3	5	1	6	0.2
2	34.0	27.2	3	4	7	1	8	0.3
3	34.0	27.2	7	20	27	9	36	1.3
4	34.0	27.2	31	15	46	14	60	2.2
5	34.0	27.2	68	45	113	49	162	6.0
6	34.0	27.2	26	16	42	18	60	2.2
7	34.0	27.2	31	27	58	25	83	3.1
8	34.0	27.2	20	5	25	5	30	1.1
9	34.0	27.2	9	6	15	0	15	0.6
10	34.0	27.2	4	5	9	0	9	0.3

Appendix B continued

Stratum 5

Transect			Observations					
			Adults		Total			
Number	Length (km)	Area (km^2)	Left obs.	Right obs.	adults	Calves	Total	Density caribou (km^2)
1	67.6	54.1	6	17	23	8	31	0.6
2	67.6	54.1	3	13	16	7	23	0.4
3	67.6	54.1	13	26	39	8	47	0.9
4	67.6	54.1	20	30	50	19	69	1.3
5	67.6	54.1	33	31	64	10	74	1.4
6	67.6	54.1	24	33	57	14	71	1.3
7	67.6	54.1	40	78	118	24	142	2.6
8	67.6	54.1	42	59	101	49	150	2.8
9	53.1	42.5	30	46	76	20	96	2.3
10	53.1	42.5	12	18	30	8	38	0.9